The Canadian Entomologist

Vol. LXXXIV Ottawa, Canada, September 1952 No. 9

The Diptera Collected by I. O. Buss in Southwestern Yukon Territory During the Summer of 1950

By MAURICE T. JAMES
State College of Washington, Pullman
and
H. C. HUCKETT
Long Island Vegetable Research Farm
Riverhead, N.Y.

During the summer of 1950, Dr. I. O. Buss, Professor of Wildlife Management, State College of Washington, made a study of the food habits and ecology of the upland plover, *Bartramia longicauda* (Bechstein), in the Duke River Meadow, five miles north of Burwash Landing, southwestern Yukon Territory (Buss, 1951). Periodical sweepings, at weekly intervals, were made through three transects of the meadow, indicated in this paper by stations 1, 2, and 3. It was from this source that the collections of insects, including a large number of Diptera, were obtained. Because of the remoteness of the region from any other in which, to the best of our knowledge, insect collecting has been done, and because of the ecological data presented by Dr. Buss, we feel that the publication of this annotated list of species is warranted.

The part of the manuscript dealing with the Anthomyiidae was written by H. C. Huckett, who made the determinations in that group; the remaining part was written by Maurice T. James, who made identifications, except that the Syrphidae were determined by C. L. Fluke, the Larvaevoridae (Tachinidae) by H. J. Reinhard, and the Tipulidae by J. Speed Rogers.

Family Tipulidae

(Identifications by J. Speed Rogers)

Tipula (*Oreomyza*) *serta* Loew. Sta. 3, July 11, 2 ♂; Sta. 2, July 11, 1 ♀; random collecting, July 13, 1 ♀.

Tipula (*Vestiplex*) sp., probably *fultonensis* Alex. Random collecting, July 8, 1 ♀.

Tipula (*Arctotipula*) sp. Random collecting, July 8, 1 ♀.

Tipula (*Oreomyza*) sp., *fragilis* group.

Family Culicidae

Culiseta alaskensis (Ludlow). Random collecting, July 5, 1 ♀.

Family Stratiomyidae

Nemotelus montanus James. Sta. 3, July 4, 1 ♂. My previous records are all from Colorado, Utah, California, and Oregon.

Family Tabanidae

Hybomitra septentrionalis (Loew). Random collecting, July 5, 11, and 21, 3 ♀.

Chrysops mitis Osten Sacken. Random collecting, July 13, 1 ♀.

Family Therevidae

***Psilocephala bussi* James, new species**

Related to *P. baccata* Coquillett and *P. argentifrons* Cole, to which it traces in Cole's key (Proc. U.S. Nat. Mus., 62 (4): 34-37), though rather imperfectly since the male genitalia are largely black-haired and the velvety spots on the front of the female are not clearly defined. In addition to the above characters it

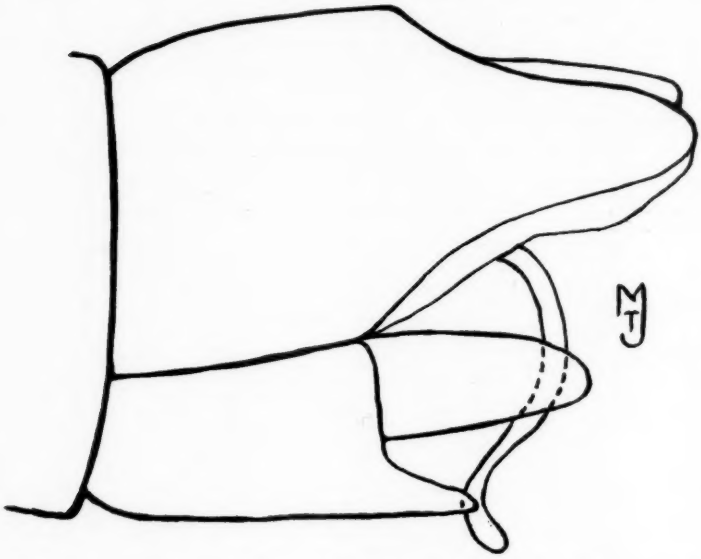

Fig. 1. *Psilocephala bussi* James. Male genitalia, side view, from holotype. Pile and setulae omitted.

may be differentiated from *baccata* by the vittate thorax and from both the above by the margined veins and the closed fourth posterior cell.

Male.—Head, including proboscis, palpi, and antennae, black in ground color, entirely cinereous-pollinose except on the apex of the frontal triangle, the very narrow frontal stripe separating the eyes, and the ocellar triangle, where the pollen is dilute brownish; pile on ocellar triangle yellow, otherwise cinereous. Eyes separated by less than half the diameter of the anterior ocellus. Antennae short; scape from lateral view slightly narrower than the flagellum; ratio of length of antennal segments 15: 5: 22; scape and pedicel with stiff setae, mostly black but with some white and yellow ones, especially below and inwardly, the longest below on scape as long as the segment; flagellum onion-shaped, intermediate in length between that of *baccata* and that of *argentifrons*; form of antenna very much as that illustrated by Cole for *cinerea* (*cf.* Cole, *l.c.*, pl. 8, fig. 95). Occiput with a row of about seven stiff black bristles marginally on each side of the occipital triangle and two to four similar bristles medially on each side.

Thorax black; three brownish-pollinose vittae on mesonotum extending almost to scutellum; pollen otherwise cinereous. Bristles black; a few very slender black hairs on the mesonotum; vestiture otherwise soft, cinereous. Halteres black, the stems somewhat yellowish-brown. Legs mainly black, the middle and hind tibiae somewhat yellowish to yellowish-brown on the basal half or more; coxae and femora with pile and pollen as on the thoracic pleura; bristles black on coxae and tibiae, lacking on femora; tibial and tarsal pile short, black. Wings milky-hyaline; veins black, distinctly margined with blackish, the infumation however limited to the vein margins and not appearing as spots; vein R_2+_3 gently bowed; cell M_3 closed and usually short-petiolate.

Abdomen densely cinereous pilose and pollinose dorsally and ventrally, yellow and black pile present only on the genitalia; genitalia mostly black and

cinereous pollinose externally; outer forceps slender, yellowish; ninth sternum angularly produced ventrally (fig. 1). Setulae of forceps yellow and black intermixed, those of apex of ninth sternum mostly black.

Length, 8 mm.

Female.—Front 0.27 head width at vertex, 0.50 at antennal bases; brownish-yellow pollinose on upper half and with two poorly-defined velvet brown spots, one adjacent to each eye, about half way on front; head otherwise cinereous pollinose. Considerable short black hairs on upper half and a few on lower half of front. Black-pollinose vittae of mesonotum much more conspicuose than in male. Abdomen mostly cinereous pollinose; second to fifth terga inclusively black pollinose except apically; first with some suggestions of brown pollen; eighth segment shining, black dorsally, yellowish ventrally; erect pile on fifth and following segments short, black. Otherwise, except sexually, as in the male, except that the cinereous pile is neither as abundant nor as long.

Types.—Holotype, ♂, 5 miles north of Burwash Landing, Yukon Territory, Duke River Meadow, Aug. 1, 1950, Coll. Sta. 1 (I. O. Buss). *Allotype* ♀, same data but Aug. 15 and Coll. Sta. 2. *Paratypes*, 9 ♂, same data but Aug. 1, Coll. Sta. 3; July 4, Coll. Sta. 2; and July 1, Coll. Sta. 1 and 3. Holotype and Allotype, State College of Washington type coll. no. 172. Paratypes have been placed in the United States National Museum, the Canadian National Museum, and the California Academy of Sciences.

Family Dolichopodidae

Scellus filiferus Loew. Sta. 1, Aug. 8, 1 ♀; Sta. 3, Aug. 1, 1 ♀; random collecting, July 19, 1 ♀, 1 ♂.

Family Syrphidae

(Identifications by C. L. Fluke)

Paragus bicolor (Fabricius). Sta. 2, July 18, 1 ♂.

Metasyrphus luniger-perplexus complex. Sta. 2, July 4, 1 ♀.

Platycheirus albimanus (Fabricius). Sta. 1, Aug. 15, 1 ♀; Sta. 2, Aug. 15, 1 ♀; random collecting, Aug. 15, 1 ♀; no data, 1 ♀.

Family Heleomyzidae

Acantholeria oediemus Garrett

A female, July 11, is referred to this species with some question, since I have not been able to distinguish the females of *oediemus* Garrett and *abnormalis* Garrett. The males of the two species are quite distinct. The following key will separate the males of the three known species of *Acantholeria*.

1. Antennae brown or brownish; hind femur beset with a comb of about nine truncated spines at the middle of the anteroventral surface ..... *cineraria* (Loew)
   Antennae bright yellow; hind femur with sharp or hooked spines on the anteroventral surface 2
2. Hind femur on anteroventral surface with a cluster of seven to twelve hooked spines; hind tibia evenly swelling to a bump in the middle ..... *oediemus* Garrett
   Hind femur with a cluster of two to four stout, straight spines on the anteroventral surface; hind tibia with a prominent finger-like projection on the basal two-fifths of the anteroventral surface and pointing, when the tibia is flexed, toward the cluster of spines on the femur ..... *abnormalis* Garrett

Family Anthomyiidae

Hylemya extremitata Malloch. Sta. 2, Aug. 1, 1 ♀, 1 ♂.

Hylemya gracilipes Malloch. Sta. 2, July 25, 1 ♂; Sta. 2, Aug. 1, 1 ♀; Sta. 2, July 18, 1 ♀. Described from Montana; known also to me from Alberta, British Columbia, Oregon, Washington, and Wyoming. In the Yukon male,

as in the holotype, the mid metatarsus has no dorsal bristles, as is present in other specimens of this species that I have examined.

Hylemya moriens (Zetterstedt). Sta. 2, July 11, 1 ♂. Described originally from Jämtland, Sweden, and from Norway. So far as I am aware this notable species has not been recorded from North America. Ringdall[1] has proposed the subgenus *Pseudomyopina* for its reception, the male having the eyes dichoptic as in the female. I have also seen specimens from Baker Lake, North West Territories.

Hylemya pullula (Zetterstedt). Sta. 1, July 4, 1 ♀.

Hylemya setiventris sobrians Huckett. Sta. 3, July 4, 1 ♂; Sta. 3, Aug. 1, 2 ♀; Sta. 3, July 18, 1 ♀, 1 ♂; Sta. 2, July 18, 2 ♀; Sta. 2, Aug. 1, 1 ♀; Sta. 2, July 11, 1 ♀; Sta. 2, July 25, 1 ♂, 3 ♀; random collecting, July 18, 3 ♂, 2 ♀; no data, 1 ♂.

Hylemya tridens Malloch. Sta. 1, Aug. 8, 1 ♀; Sta. 2, Aug. 1, 2 ♀; Sta. 2, July 25, 1 ♀.

Pegomya tarsata (van der Wulp). Sta. 2, July 18, 1 ♀.

Hoplogaster mollicula (Fallén). Sta. 3, July 4, 1 ♀.

Coenosia aliena Malloch. Sta. 2, July 11, 1 ♀.

Coenosia alticola Malloch. Sta. 2, July 18, 1 ♀; Sta. 3, July 11, 1 ♀. Described from Huntington Lake, California. Additional records are known to me from Oregon and Utah.

Coenosia pedella (Fallén). Sta. 1, July 4, 1 ♀; Sta. 1, July 7, 1 ♀; Sta. 2, July 11, 1 ♂, 7 ♀; Sta. 2, July 18, 3 ♀; Sta. 3, July 11, 2 ♀; Sta. 3, July 4, 3 ♀; Random collecting, July 19, 4 ♀. Malloch[2] recorded this nominally Swedish species under the name *Coenosia dichaeta* from North America, the types coming from Colorado and Saskatchewan. Additional material is known to me from Alberta, British Columbia, Montana, Quebec, and from Fort Simpson and Fort Wrigley, McKenzie River, North West Territories.

Coenosia geniculata (Fallén). Sta. 1, July 4, 1 ♀; Sta. 2, July 11 and 18, 2 ♀; Sta. 3, July 11 and 18, 2 ♀.

Spilogona crassiventris Huckett. Sta. 3, July 11, 1 ♂; Sta. 3, July 18, 1 ♀.

Spilogona fuscomarginata Huckett. Sta. 2, July 11, 1 ♀.

Spilogona spp. Two females, damaged; Sta. 2, July 18, and Sta. 3, July 18.

Helina duplicata (Meigen). Sta. 1, July 4, 11, and 18, 4 ♀; Sta. 1, Aug. 1, 1 ♀; Sta. 2, July 4, 2 ♀; Sta. 3, July 4, 1 ♀.

Mydaea armatipes Malloch. Sta. 3, Aug. 1, 1 ♂. Malloch originally named this species *armata* (preoc. Stein).

Hydrotaea scambus (Zetterstedt). Sta. 2, July 4, 2 ♀; Sta. 3, July 4, 11, and 18, 4 ♀.

Lasiops nigrifrons (Walker). Walker's type, a female, was described from St. Martin's Falls, Albany River, Manitoba, and I[3] have reported it as being similar to that of *Lasiops spiniger* (Stein). More recently Ringdall[4] has recorded *spiniger* and *Lasiops septentrionalis* (Stein), both described from North America, as synonyms of *nigrifrons*. I have been unable to find any satisfactory character for separating the females of these two forms; hence their proper relationship to *nigrifrons* is to me at present uncertain. Both forms are widely distributed in the Canadian Zone. Sta. 3, July 18, 1 ♀.

1Ringdall, O. 1933 Ent. Tidskr. 54 (1): 31.
2Malloch, J. R. 1920. Trans. Amer. Ent. Soc. 44: 163-164.
3Huckett, H. C. 1934. *Canad. Ent.* 66: 138.
4Ringdall, O. 1947. *Opus. Ent.* 12 (1-3): 94.

Family Calliphoridae

Calliphora livida Hall. Random collecting, July 18, 2 ♀.

Family Larvaevoridae

(Identifications by H. J. Reinhard)

Wagneria helymus (Walker). Sta. 1, Aug. 8, 1 ♀; Sta. 2, July 18, 1 ♀.

Literature Cited

Buss, I. O. 1951. The Upland Plover in southwestern Yukon Territory. *Arctic*, 4 (3): 204-213.

Another Method of Rearing Grasshoppers (*Orthoptera*) in the Laboratory[1]

By R. W. Smith[2]

Dominion Parasite Laboratory, Belleville, Ontario

Numerous methods of rearing grasshoppers under laboratory conditions have been described (Brett, 1947; Carothers, 1937; Haydak, 1942; Parker, 1930). One now used at the Belleville laboratory to provide hosts for small-scale propagation of parasites has been very satisfactory for the rearing of several species of Cyrtacanthacrinae and Oedipodinae. It most closely resembles the method described by Haydak (1942), but requires only one type of cage. The rearing is done in a room with a constant temperature of 24°C. and a relative humidity of 50-60 per cent. The method described is dependent upon the use of field-collected eggs.

The cage (Fig. 1), 18 inches square and 10 inches deep, is of wooden-frame construction and is covered on three sides with 20-mesh copper-wire screening. The fourth side is of plywood and is provided with a four-inch circular opening for easy access to the cage. The opening is closed with a slide of clear plastic. The bottom of the cage is of 12-mesh copper-wire screening; the top is a sheet of glass held in place by gravity. The cage is set in a shallow tray about one inch deep and made of composition board with a light marginal frame of wood.

The food used is a dry mixture of alfalfa meal (or Cerogras[3]), 75 grams; powdered whole milk, 25 grams; dried brewers' yeast, 5 grams; and sodium chloride, 0.5 grams. This mixture is available to the grasshoppers at all times. It is either scattered on the floor of the cage or fed from a hopper as explained later. For the larger nymphs and adults, lettuce leaves or wheat blades are usually added as a supplement, although the grasshoppers are able to complete their development on the dry food mixture alone.

Water is provided by inverting a jelly jar or a tumbler over a disc of white blotting paper on a petri-dish base (Fig. 2, A). A narrow notch in the edge of the disc of paper allows the air to enter more freely and helps to keep the exposed portion of the blotter well saturated with water.

Additional heat and light are provided by placing a 100-watt lamp against the side of the cage. This is usually in operation for only eight of each 24 hours but may be operated continuously to hasten development. Temperatures within the cage range from 26° to 35°C.

1Contribution No. 2958, Division of Entomology, Science Service, Department of Agriculture, Ottawa, Canada.

2Agricultural Research Officer.

3Dehydrated cereal grasses, a product of the Greenmelk Co., Wallaceburg, Ontario.

To prepare the cage for use it is set in a tray and a sufficient quantity of fine sand added to cover the bottom screen. This prevents the escape of the smaller nymphs and also provides a suitable surface on which to scatter the dry food mixture. The food is now added. A water fountain is placed in the cage near the opening in the plywood panel, and a generous handful of excelsior is placed in a corner to provide additional resting surface and shelter for the grasshoppers. The glass top is put in place and the cage is ready for use.

To obtain a supply of nymphs a number of egg-pods are removed from cold storage and placed on a shallow layer of sand in a pint jar (Fig. 2, B). Another layer of sand, sufficient to cover the egg-pods, is placed on top and enough water added to wet the contents thoroughly. A small quantity of excelsior is placed in the jar to provide resting space for the emerging nymphs. The container is covered with a double layer of fine cheesecloth secured with an elastic band. Water is added from time to time as the sand becomes dry.

Newly emerged nymphs are transferred from the jar to the large rearing cage with an aspirator-collector. The collector consists of a glass nozzle of half-inch tubing, a filter, and a length of rubber tubing. The nymphs are blown into the cage through the opening in the plywood panel.

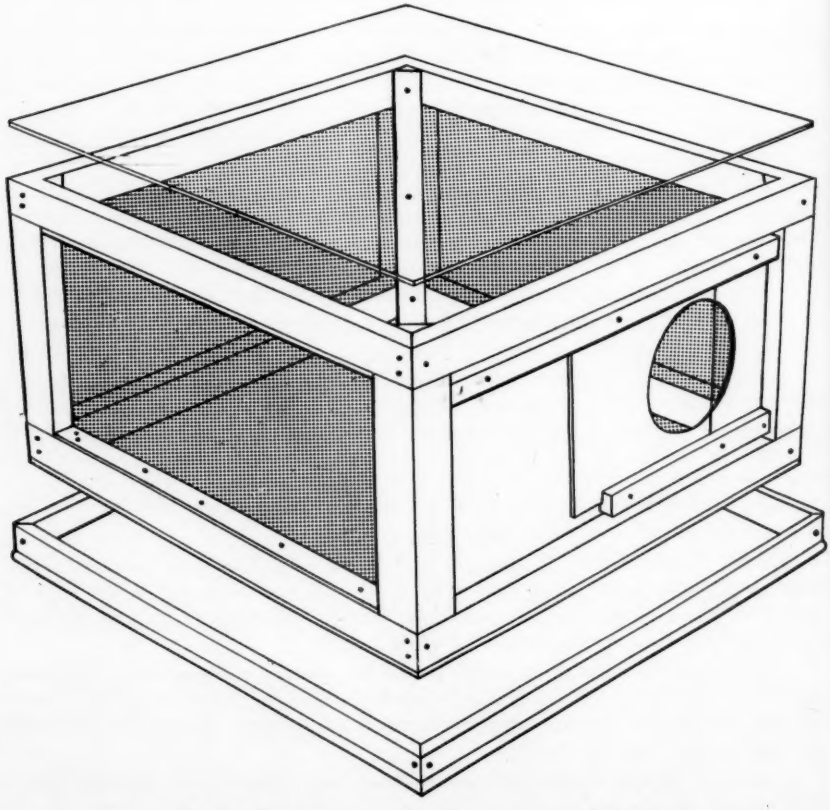

Fig. 1. Grasshopper rearing cage, 18 x 18 x 10 inches.

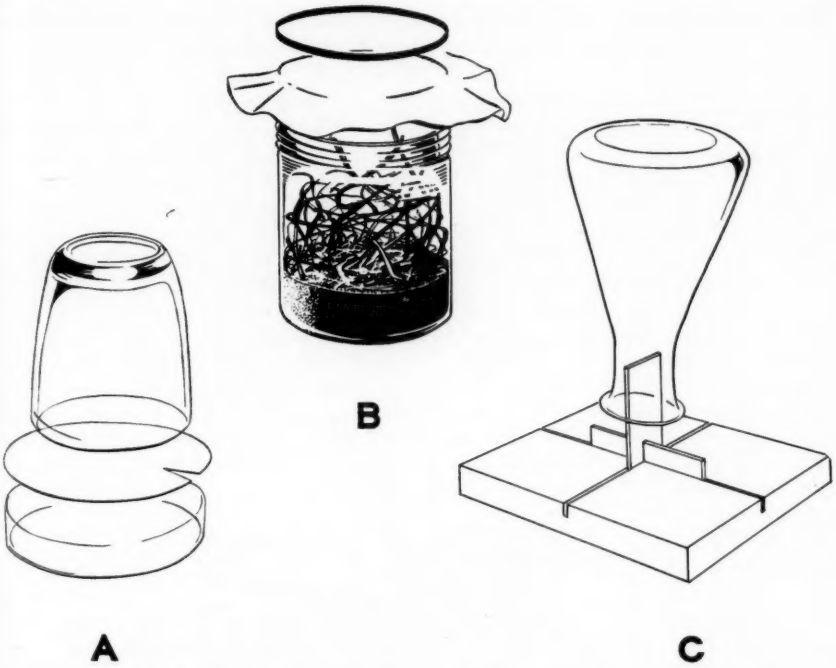

Fig. 2. A, Drinking fountain. B, Jar for incubation of eggs. C, Hopper for dry food mixture.

As soon as the grasshoppers reach the adult stage they are transferred to another but similar cage. This cage is raised slightly above its tray and the sand omitted so that the frass will drop free of the cage through the coarse bottom screening. Since the dry food mixture will not remain on the bare screen, it is placed in a hopper (Fig. 2, C) consisting of a 250-ml. Erlenmeyer flask held upright and slightly above a small plywood base with a cross of clear plastic. The plastic is inserted in sawcuts in the base.

With an initial 300 to 400 nymphs placed in a cage, survival to the adult stage has varied from 25 to 80 per cent. Nymphs usually emerge from the eggs after an incubation period of seven to 14 days at 25°C. Development from first-instar nymph to adult is usually completed in 30 to 35 days.

References

Brett, C. H. 1947. Interrelated effects of food, temperature, and humidity on the development of the lesser migratory grasshopper *Melanoplus mexicanus mexicanus* (Saussure) (Orthoptera). *Oklahoma Agr. Expt. Sta. Bull.* T-26.

Carothers, E. E. 1937. Culture methods for grasshoppers. *In* Culture methods for invertebrate animals, ed. by Paul S. Galtsoff, pp. 287-291. Comstock Pub. Co., Ithaca, N.Y.

Haydak, M. H. 1942. Rearing grasshoppers under laboratory conditions. *Science* 95: 657-658.

Parker, J. R. 1930. Some effects of temperature and moisture upon *Melanoplus mexicanus mexicanus* Saussure and *Camnula pellucida* Scudder (Orthoptera). *Univ. Montana Agr. Expt. Sta. Bull.* 233.

The Life-History and Galls of a Spruce Gall Midge, *Phytophaga piceae* Felt (Diptera: Cecidomyiidae)[1]

By C. C. Smith[2]
Laboratory of Forest Zoology, Fredericton, N.B.

The adults of *Phytophaga piceae* Felt were described (1) from shoots of white spruce, *Picea glauca* (Moench) Voss., collected in Manitoba by Swaine in 1926. Felt stated that the shoots suggested the galls of *Chermes similis* Gill., but he did not describe them. The life-history was unknown. Twigs of white spruce showing damage of a similar nature were collected by Swaine at Fort Coulonge, P.Q., in 1919, but no adults were obtained from this sample.

In June 1948, a white spruce tree at Fredericton, N.B., was found with most of the shoots of the previous year's growth distorted and dead. Since that time a few similarly injured trees have been found in the vicinity of Fredericton. Samples of injured twigs were also received from F. G. Cuming and G. V. Moran, Forest Insect Survey Laboratory, Division of Forest Biology, Truro, N.S., collected from red spruce, *Picea rubens* Sarg., at Kentville, N.S., and from white spruce near Earltown, N.S. It is probable that the insect occurs fairly generally in the Maritimes but is not sufficiently common to attract attention, except on occasional severely infested trees. Apparently individual trees are particularly susceptible to attack.

Adults reared from the shoots were identified by Mr. G. E. Shewell, Systematic Unit, Division of Entomology, Ottawa.

Description of Stages

Adult.—Both the males and females are approximately 1.5 mm. long. The head and thorax are dark-brown. The abdomen is dark reddish-brown. The ovipositor is yellowish-orange, and is about the same length as the body. Detailed descriptions of both sexes are given by Felt (1).

[1]Contribution No. 40, Division of Forest Biology, Science Service, Department of Agriculture, Ottawa, Canada.
[2]Laboratory of Forest Zoology, Fredericton, N.B.

Photo by L. E. Williams

Fig. 1. Section of infested shoot showing mature larva in cell. X10

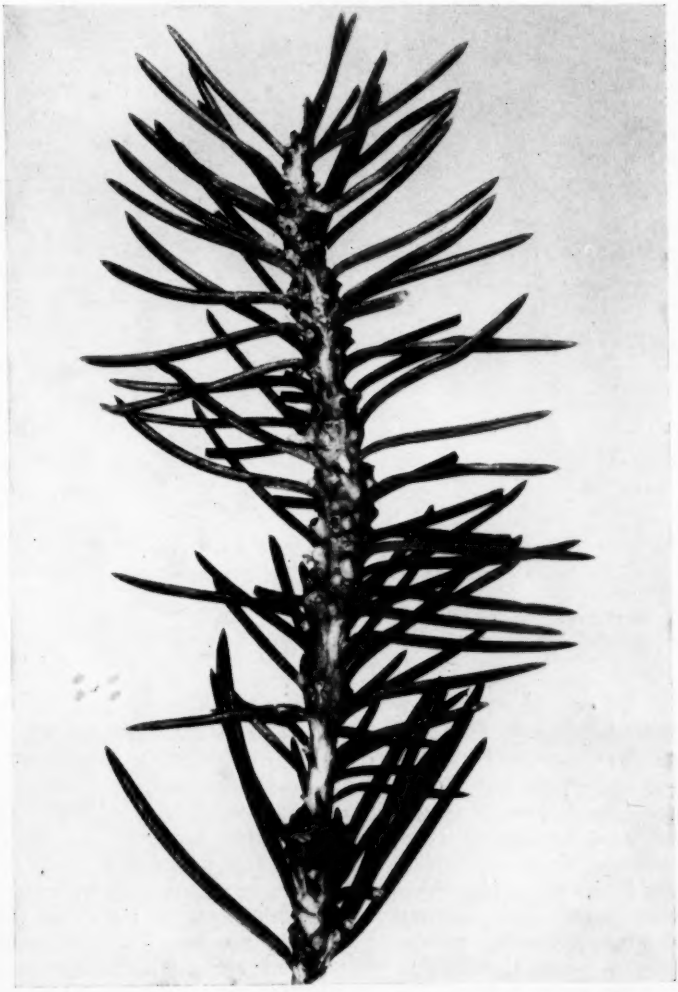

Fig. 2. Heavily infested shoot in late May of year following attack. Note swelling and adult emergence holes. X2

Egg.—About 0.25 mm. in length; elongate, oval, very light-orange in colour; chorion fragile and transparent with developing embryo showing through.

Larva.—The first instar slightly more than 0.25 mm. in length, very light-orange in colour. Final instar from 1.28 to 1.66 mm. in length, light reddish-orange in colour (Fig. 1).

Pupa.—About 1.5 mm. in length; moderately stout, broadly rounded at both extremities, orange to reddish-orange in colour. As development takes place, the form of the pupa can be seen through the larval skin; two dark spots appear where the eyes are forming and the reddish thorax and the antennae become visible.

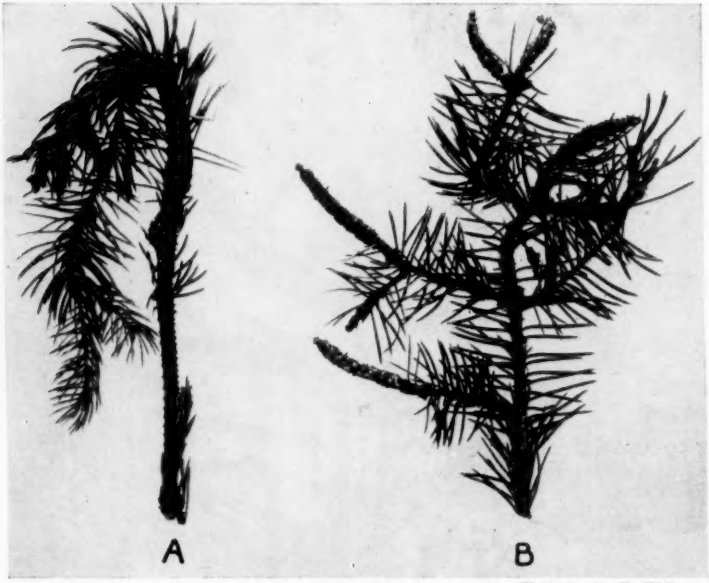

Photo by L. E. Williams

Fig. 3. A. Bent shoot that survived attack.
B. Shoots killed by insect. Note white fungus on lower shoot.

Life-history

In 1949 adults emerged from the galls between May 15 and 31. Oviposition occurred a few days after emergence. The majority of the eggs were laid at the bases of the needles on the new shoots; a few, however, were laid under the bud scales. The number of eggs per shoot was not determined but as many as 100 larvae were counted in a single shoot. After hatching, the larvae bore directly into the shoot and form a cell. In a few instances as many as three larvae were found occupying the same cell, but were separated by a thin white membranous tissue. The galls begin to form shortly after the larvae enter the shoot and swelling becomes noticeable about 10 days later. The larvae develop within the cells during the summer and remain there until the following spring. Pupation occurs early in May, within the cells, but in many instances the pupae were observed protruding from a hole in the cell before the adults emerged. The empty pupal cases remained in the holes for some time after emergence (Fig. 2).

Description of Galls and Damage

The insect attacks the current year's shoots of white spruce and causes them to curl or twist, and swell to about twice their normal diameter. The cells are about 1.8 to 2 mm. in length on the inside. Externally they appear as hemispherical swellings between the sterigmata. After the adults come out of the galls, the emergence holes are noticeable on the swollen shoots (Fig. 2). Following the year of attack, the majority of the heavily infested shoots die, many of the needles drop off, and the trees show a rather unhealthy appearance. The injured shoots often bear a white fungus (Fig. 3). This fungus was identified by Dr. V. J. Nordin of the Laboratory of Forest Pathology, Fredericton, as

Ascochyta piniperda Lind. He stated that it appears evident that this fungus was established following the insect infestation.

When the attack is not too severe, the shoots may survive and they sometimes continue to grow in a "curled" fashion not unlike the curl of a pig's tail.

Natural Control

This species was found to be heavily parasitized. In July 1948 several chalcid parasites were noted crawling on the infested shoots. Specimens were identified by Dr. O. Peck of the Systematic Unit, Division of Entomology, Ottawa, as belonging to the genera *Torymus* and *Amblymerus*. In the spring of 1949 several chalcid parasites were reared from *P. picea*. These were identified by Dr. Peck as follows: *Amblymerus* sp., *Tetrastichus* sp., and two species of the genus *Torymus*. Dr. Peck stated that the *Amblymerus* was the same species as that attacking the closely related *Rhabdophaga swainei* Felt referred to in a recent paper by Clark (2). During the summer of 1949 about 80 per cent of the larvae died from unknown causes.

References

1. Felt, E. P. 1926. A new spruce gall midge (Itonididae). *Can. Ent.* 58: 229.
2. Clark, J. The spruce bud midge, *Rhabdophaga swainei* Felt. *Can. Ent.*

Book Review

***The aphid genus Periphyllus, a systematic, biological, and ecological study.* By E. O. Essig and Frieda Abernathy. Pp. IX and 166, with frontispiece and 41 sets of figures. The University of California Press: $3.00.**

Aphids of the genus *Periphyllus* occur on maples in both the Old and New worlds. In the book under review the authors give a detailed summary of information on all aspects of the study of the ten known species. Much of this information is new and is the result of six years' intensive study of the genus. This study was made difficult by the complex life-histories; the California maple aphid, for example, has no fewer than 17 forms of individuals. The authors discuss the nomenclature, history, and ecology of each species, and describe the life-histories, distributions, and taxonomy. Taxonomic characters of all known forms of each species are illustrated by good line drawings arranged in groups, usually as full-page plates. There is an extensive bibliography. The extent of the field covered and the clarity with which the information is given make the book as useful to the forester as to the aphid taxonomist. Few other aphid genera can have been studied so intensively. Consequently, the authors' statement (p. 5) "There is every reason to believe that there still remain many unknown and undescribed species of *Periphyllus* occurring on maples throughout the world" emphasizes the amount of work that remains to be done on the taxonomy and bionomics of aphids as a whole.

BRYAN P. BEIRNE

A New Nearctic Species of *Rhaphium*, with Notes on Other Species (Diptera: Dolichopodidae)[1]

By J. R. VOCKEROTH[2]
Systematic Entomology, Division of Entomology
Ottawa, Canada

The species of *Rhaphium* Mg. (s.l.) may be divided, for convenience, into two groups—those with white-faced males and those with black-faced males. Since the North American species of the genus were last revised (Curran, 1926, 1927), 13 species belonging to the former group have been described. In this paper one species with black-faced males is described as new, one is recorded from the Nearctic region and one from Canada for the first time, and one species with white-faced males is also recorded from Canada for the first time.

Key to Males of the Black-faced Group

1. Outer genital lamella simple, unbranched 2
   Outer genital lamella with two or three branches 5
2. Posterior tibia with basal half white or pale yellow, apical half swollen and black. Middle basitarsus with strong bristles below ..... *fascipes* (Mg.)
   Posterior tibia without contrasting colours as above. Middle basitarsus without strong bristles below 3
3. Inner genital appendage very short ..... *boreale* (V.D.)
   Inner genital appendage long, slender (Fig. 1) 4
4. Outer genital appendage tapering evenly from base to apex. Cilia of squama white ..... *terminale* (V.D.)
   Outer genital appendage abruptly narrowed just before the middle, then tapering gradually to the apex (Fig. 1). Cilia of squama brownish ..... *unistylatum* n. sp.
5. Outer genital appendage with three branches, the two shorter arising from a common base (Fig. 2) ..... *tripartita* (Frey)
   Outer genital appendage with two branches 6
6. Middle coxa with a downward-directed spine formed of close-set bristles 7
   Middle coxa without spine. Longer branch of the outer appendage about three times as long as shorter ..... *nudum* (V.D.)
7. Longer branch of the outer appendage less than twice as long as the shorter ..... *nigrociliatum* Cur.
   Longer branch of the outer appendage at least four times as long as the shorter 8
8. Cilia of squama pale. Posterior femur yellow on basal third or more ..... *vanduzeei* Cur.
   Cilia of squama black. Posterior femur black with yellow apex ..... *nigrum* (V.D.)

***Rhaphium unistylatum* n. sp.**

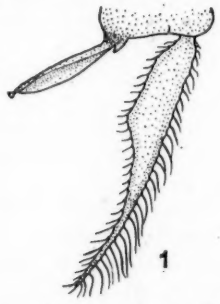

Fig. 1. *Rhaphium unistylatum* n. sp. Genital appendages.

Male.—Length 4.8 mm., wing 4.4 mm. Face black, rather broad. Front black, shining. Palpus black with brownish hairs. Beard black. Eye with

[1]Contribution No. 2933, Division of Entomology, Science Service, Department of Agriculture, Ottawa, Canada.
[2]Agricultural Research Officer.

reddish-brown hairs below, blackish hairs above. Antenna black, third segment twice as long as wide, arista one-third again as long as rest of antenna, twice as long as third segment. Occiput greenish-black, shining. Bristles and cilia of occiput black.

Mesonotum and scutellum black with greenish reflections, sub-shining. Mesonotum with traces of one medial and two lateral brownish stripes on posterior half. Pleura black with greenish reflections, darker posteriorly.

Abdomen shining green with coppery reflections, sternites slightly pollinose. Genital segments black. Outer genital appendage (Fig. 1) pale brown, elongate, broad basally, abruptly narrowed just before the middle, then tapering gradually to the apex. Inner genital appendage darker, more heavily sclerotized, long, slender, with a small flattened projection at the tip.

Coxae black. Mid coxa with a long, black, downward-directed spine composed of close-set bristles; hind coxa with two or three black, downward-directed bristles, but without lateral bristles. Femora black, slightly brown-pollinose, extreme apices of fore and mid femora slightly yellowish. Tibiae yellow, infuscated or blackened at extreme base. Fore and mid tarsi yellow basally, becoming darker apically, covered with pollen that appears black in some lights. Mid tarsus with a patch of short, black bristles beneath at base. Hind tarsi missing.

Wing slightly cinereous. Haltere yellow, squama yellow with brown cilia.

Female.—Length 4.8 mm., wing 5.2 mm. Face one-fourth as wide as head, covered with silvery pollen. Palpi black, silver-pollinose, with black hairs. Front and occiput metallic green, covered with silvery pollen. Antenna back; third segment short, scarcely longer than wide, arista almost three times as long as remainder of antenna. Beard white.

Mesonotum and scutellum metallic bronze-green, silver-pollinose from some angles. Metanotum and pleura of same colour, pollen heavier. Mesonotum with a bristle between the dorsocentrals and the presutural.

Tergites metallic bronze-green, slightly pollinose; a few white hairs on lateral margins of first three tergites, other hairs black. Sternites blackish; hairs on fifth sternite black, on other sternites white.

Coxae black with heavy silver pollen, white-haired except for a few small, black, bristly hairs at apices of fore and mid coxae. Femora black, apices of fore and mid femora yellow. Tibiae yellow, hind tibia with apex blackish. Fore and mid tarsi yellow, darkened apically; hind tarsi black.

Wing membrane slightly brownish. Haltere yellow. Squama yellow with yellowish cilia.

Holotype, male, and allotype, female, Reindeer Depot, Mackenzie Delta, N.W.T., July 13, 1948 (J. R. Vockeroth); paratype, female, Reindeer Depot, Aug. 6, 1948 (W. J. Brown). Type No. 5985, Canadian National Collection, Ottawa, Canada.

This species resembles *R. terminale* (V.D.) very closely, but the male of that species has a much narrower face, white squamal cilia, and an evenly tapering outer genital appendage.The female of *terminale* has the legs almost entirely yellow (femora black in *unistylatum*) and the black hairs on the fore and mid coxae are finer and fewer in number than in *unistylatum.*

***Rhaphium tripartita* (Frey)**

Porphyrops tripartita Frey, 1913, Acta. Soc. Fauna et Flora Fenn. 37: 13.

This species has not hitherto been recorded from North America. It was

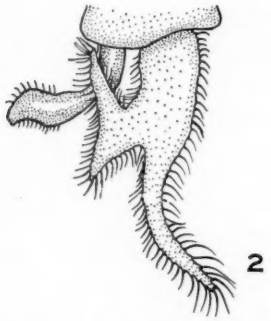

Fig. 2. *Rhaphium tripartita* (Frey). Genital appendages.

described from a male collected in northern Russia; since the original description is not readily available, and the female is undescribed, descriptions of both sexes are given here.

Male.—Length 5.2 mm., wing 4.8 mm. Face black, velvety, rather broad. Front black, black-haired. Palpus shining black, with black hairs. Antenna black, third segment twice as long as wide, arista twice as long as third segment.

Thorax greenish-black, slightly pollinose. Mesonotum with two darker, sub-shining, sub-median stripes.

Abdomen greenish-black, sub-shining; pollen slightly heavier along the mid line. Base of genitalia black; appendages (Fig. 2) brownish. Outer appendage three-branched, the two anterior branches short, with a common base, the posterior branch much longer. Inner appendage heavy, broad, apically slightly enlarged and with an internal projection.

Legs mostly black; anterior basitarsus and all but the apices of the first two segments of the mid tarsus, yellow. Mid coxa with a downward-directed apical spine of close-set, black bristles; hind coxa with a similar spine of two or three bristles only. Hind coxa without lateral bristles.

Wing faintly brownish. Squama brown with black cilia. Haltere with brown stem and dark-brown knob.

Female.—Length 4.4 mm., wing 4.8 mm. Face broad, with golden-brown pollen. Front greenish, slightly less pollinose than the face. Palpus black, greyish-pollinose, black-haired. Antenna black, third segment barely longer than wide, arista 1.8 times as long as rest of antenna. Occiput greyish, beard yellowish.

Thorax metallic green, mesonotum heavily dusted with golden-grey pollen, pleura with grey pollen. Mesonotum with a dark-brown sub-median stripe on either side reaching to the prescutellar area. A small bristle present between the dorsocentrals and the sutural.

Abdominal tergites metallic golden-green, grey pollinose; pollen heavier on the fifth tergite. First and second tergites with a few white hairs along the lateral margins, tergites otherwise black-haired. Sternites grey, white-haired.

Fore femur darkened except at apex; mid femur very slightly darkened at base below; hind femur usually darkened at apex above; femora otherwise reddish-yellow. Tibiae usually slightly darkened at extreme base, otherwise reddish-yellow. Tarsi yellowish basally, darkened apically. Coxae dark grey, pollinose. Fore coxae white-haired anteriorly with heavier, black hairs near the

apex; mid coxa with a few white hairs basally, otherwise black-haired; hind coxa with black hairs only at apex, and without lateral bristles.

Wing greyish-brown, membrane slightly darker along the veins. Cilia of squama yellow-brown. Haltere yellowish, the apex of the knob slightly darker.

Specimens examined: Reindeer Depot, Mackenzie Delta, N.W.T., 3 ♂ ♂, 6 ♀ ♀, July 1-13, 1948 (J. R. Vockeroth); Chesterfield Inlet, N.W.T., 1 ♂, 2 ♀ ♀, July 27-30, 1950 (J. R. Vockeroth); Coral Harbour, Southampton Island, 4 ♂ ♂, 5 ♀ ♀, July 9-20, 1948 (G. E. Shewell).

Dr. Richard Frey of Helsingfors has very kindly compared a sketch of the genital appendages of a North American male with those of a European male of *tripartita*, and has informed me that they appear to be identical.

One of the female specimens from Chesterfield Inlet has the posterior cross-vein absent from one wing and represented only by a minute stump in the other. Otherwise, the wings appear characteristic.

This species is widespread in the American Arctic but it is not abundant. At Chesterfield Inlet and Coral Harbour, Dolichopodidae were collected intensively throughout the summer; in both localities *tripartita* was the scarcest of the species of Dolichopodidae taken.

***Rhaphium temerarium* (Becker)**

Xiphandrium temerarium Becker, 1921, Abh. Zool.-Bot. Ges. in Wien 13: 150.

Two males [Watson Lake, Y.T., June 17, 1948 (Mason and Hughes); Churchill, Man., June 28, 1948 (G. E. Shewell)] differ in a number of characters from specimens of *temerarium* from Colorado. The legs, especially the mid femora, are much paler, the third antennal segment is longer and the arista shorter, and the outer genital appendage is longer and somewhat narrower. These specimens may represent a northern subspecies or even a distinct species.

***Rhaphium terminale* (Van Duzee)**

Xiphandrium terminale Van Duzee, 1924, Proc. U.S. Natl. Mus. 63, Art. 21: 7.

Two males and three females from Reindeer Depot, Mackenzie Delta, N.W.T., July 10-13, 1948 (J. R. Vockeroth) agree very well with male and female paratopotypes. This is the first record of the species outside Alaska.

The important references to the North American species of *Rhaphium* were given by Curran (1926; 1927). This list is brought up-to-date here.

aequalis Van Duzee, Pan. Pac. Ent. 3: 147, 1927 [*Rhaphium* (*Xiphandrium*)]. Idaho.

browni Curran, Am. Mus. Nov. 492: 2, 1931 (*Rhaphium*). Quebec.

ciliatum Curran, Canadian Ent. 61: 30, 1929 (*Rhaphium*). British Columbia.

colutis Harmston & James, Canadian Ent. 74: 83, 1942 (*Rhaphium*). Colorado.

elongatum Van Duzee, Am. Mus. Nov. 599: 4, 1933 [*Rhaphium* (*Xiphandrium*)]. Quebec.

furcifer Curran, Am. Mus. Nov. 492: 2, 1931 (*Rhaphium*). Quebec.

hirtimanus Van Duzee, Am. Mus. Nov. 599: 6, 1933 [*Rhaphium* (*Xiphandrium*)]. Oregon.

latifacies Van Duzee, Ent. News 41: 53, 1930 (*Rhaphium*). Alberta.

longibarba Van Duzee, Ent. News 41: 53, 1930 (*Rhaphium*). Alberta.

lugubre Loew. Van Duzee, Am. Mus. Nov. 596: 16, 1932. Description of male.

rossi Harmston and Knowlton, J. Kansas Ent. Soc. 13: 2, 1940 (*Rhaphium*). Illinois.

septentrionale Curran, Am. Mus. Nov. 492: 4, 1931. (*Rhaphium*). Quebec.

subfurcatum Van Duzee, Am. Mus. Nov. 521: 8, 1932 (*Rhaphium*). Wyoming.

tripartita Frey, Acta Soc. Fauna et Flora Fenn. 37: 13, 1913 (*Porphyrops*). Russia.

wheeleri Van Duzee, Am. Mus. Nov. 521: 8, 1932 (*Rhaphium*). Wyoming.

Reference

Curran, C. H. 1926. The Nearctic species of the genus *Rhaphium* Meigen (Dolichopodidae, Dipt.). *Trans. Roy. Canadian Inst.* 15: 249-260. 1927 (*Cont'd.*) 16: 99-179, pl. 3-6.

Circumpolar Distribution of Water Boatmen (Hemiptera: Corixidae)

By R. I. Sailer
Bureau of Entomology and Plant Quarantine
Agricultural Research Administration
United States Department of Agriculture

Only two species of Corixidae, commonly known as water boatmen, are known to occur in both the Old and New Worlds. One of these is *Callicorixa producta* Reuter, which Hungerford (1948) has divided into three subspecies. On the basis of existing records the typical subspecies is restricted to the Scandinavian peninsula and Finland. The second subspecies, *producta sackalinensis* (Matsumura), is so far known only from northern Manchuria and Sakhalin Island. The third subspecies, *producta noorvikensis* Hungerford, appears to straddle the Bering Sea, specimens being recorded from near Kolyma River in Siberia and from Bering Island in the Komandorskies east across Alaska and Northwest Territories to Hudson Bay.

The second species known to occur in both hemispheres is *Glaenocorisa quadrata* Walley. In 1948 Hungerford was able to record *quadrata* from four localities. Three of these were New World, Newfoundland, northern Quebec, and the Mackenzie Delta being represented. The fourth record is represented by two specimens from Aal, Norway.

Through the kindness of Major J. M. Geary, of the Arctic Aeromedical Laboratory, located at Ladd Field, Alaska, I am privileged to report the first Alaskan record for *Glaenocorisa quadrata.* This is based on five specimens collected by Major Geary, January 26, 1951, at Hurricane Gulch in the Alaska Range. The specimens were taken under quite interesting circumstances, for he writes that they were collected from water flowing from a hole chopped through 18 inches of ice. The pond from which they came was about 150 yards and was fed by a fast-flowing stream which was also completely covered by ice. Air temperature at this time was minus 36°F., and the water was believed to be "super-cooled" as a result of pressure. The specimens were alive and active.

According to Dr. H. B. Hungerford, who examined the specimens, they appear to differ in no significant way from those taken either in Newfoundland or in Norway; so it seems probable that the species occurs across Arctic North America and Arctic Eurasia. If this is true, *quadrata* is the only corixid species having a structurally uniform population throughout the circumpolar regions.

One other European species has been erroneously reported from Alaska. This is *Callicorixa praeusta* (Fieber). References to this species from Alaska are shown by Hungerford to refer to the North American species *Callicorixa alaskensis* Hungerford.

Literature Cited

Hungerford, H. B. 1948. The Corixidae of the Western Hemisphere (Hemiptera). *Univ. Kans. Sci. Bul.* 32: 1-837.

Adult Mosquito Control by Airspray in Northern British Columbia and the Yukon[1]

By J. F. SHARP[2]
Household and Medical Entomology, Division of Entomology
Ottawa, Canada

Experimental aerial spraying to control mosquitoes was carried out in 1949 and 1950 at several stations of the Royal Canadian Air Force in northern Canada. An account of the work in 1949 has been presented (Twinn, Brown, and Hurtig, 1950). The experiments in 1949 involved the use of a larvicide, followed by a spray against the adults. Further data were required on the degree of effective control that could be obtained by applying one or two sprays against the adult mosquitoes only, in plots of reasonable size. Consequently, in 1950, arrangements were made with the R.C.A.F. to carry out airspray operations against adult mosquitoes at four stations in the Northwest as follows: Fort Nelson, B.C., 24 sq. mi. in two operations, June 6-8 and 19-20; Whitehorse, Y.T., 22 sq. mi. in two operations, June 13-15 and June 30-July 1; Watson Lake, Y.T., 12 sq. mi. June 21-22; and Norman Wells, N.W.T., 8 sq. mi. June 28-29.

Equipment and Materials

The spray equipment was the same as was used in 1949 (Twinn *et al.*, 1950). An R.C.A.F. Dakota (DC-3) aircraft was fitted with two 300-gal. (imperial) tanks and an assembly that led below the fuselage to a straight 18-in. emission pipe 2.5 in. in diameter. Calibration in previous work had shown the output to average 2.25 gal. per sec. This gave approximately 200 sec. of spray time per load of 500 gal. of insecticide and left sufficient spray in the tanks (25 gal. in each) to maintain the pressure. The plane was flown at 150 m.p.h., so that each load covered approximately one square mile at a swath width of 200 yds.

A 30 per cent (by weight) DDT concentrate in Velsicol AR-50 was shipped in 45-gal. drums to each of the stations during the early spring. In addition, a number of drums of concentrate left over from the previous year were available. The old concentrate had crystallized in the bottoms of the drums and even the new material had crystallized considerably. In order to put it back into solution, dry steam was forced into the drums under 40 to 50 lb. pressure. With constant stirring it was possible to get the DDT back into solution.

Mixing and Loading

To prepare the insecticide for use, one 45-gal. drum of the DDT concentrate was mixed in an oil tender with 455 gal. of No. 2 fuel oil, for each plane load. This gave 500 gals. of 3.5 per cent DDT solution, of which 250 gals. of the mixture was pumped into each tank in the aircraft. At two stations oil tenders were not available to mix the insecticide. Accordingly, the concentrate was pumped directly into the tanks from the barrels by means of a gasoline-driven pump, simultaneously with the fuel oil; then the insecticide was circulated for a few minutes by means of a connection between the emission pipe and the pump. It was possible to load the plane in 15 to 20 minutes.

Operation Procedure

The areas treated at each station were selected with the camp approximately in the centre, although terrain and prevailing winds were also taken into

1Contribution No. 2932, Division of Entomology, Science Service, Department of Agriculture, Ottawa, Canada. The results herein reported were obtained in a program of studies of biting flies being carried out in co-operation with the Defence Research Board and the Royal Canadian Air Force, Department of National Defence.

2Assistant Entomologist.

consideration. A base line was marked with stakes at 200-yd. intervals. The runs were plotted on maps on which were also shown the time of emission for each run and the number of runs per load (Figs. 2, 4, 6, 8). Copies of these maps were given to the co-pilot for his guidance. The spray was applied at 0.7 gal. per acre and gave a coverage of 0.23 lb. of DDT per acre. The ground party maintained contact with the control tower and the aircraft by means of a radio set mounted on a vehicle. The equipment found most serviceable was an SCR-522-VHF set powered by six wet batteries.

Data on wind speed and direction were obtained from the control tower, and the height for each run was computed and radioed to the pilot. In computing the height of the plane, the "height-wind product" formula (Twinn *et al.*, 1950) was used, a product of 1,000 being the basic figure, but this varied with meteorological conditions at the time of spraying. For instance, the plane was not flown higher than 500 ft., because at greater heights there is too much loss of the spray particles by drifting and evaporation. The appearance of the spray as it fell and the pattern produced on stones along the base line also were of assistance in determining the most effective height for good coverage. To facilitate the computation, an operation chart was prepared for each station as shown for Whitehorse in Fig. 1; Table 1 was also prepared, to give the cross-wind component for Cos Θ by wind speed, at angles of 5° to 85° and wind speeds of 2 to 15 m.p.h.

To determine from the wind speed and direction the height at which the plane should be flown for any given run, the number of degrees off the direct cross-wind was ascertained from the chart (Fig. 1) and the cross-wind component was then read from the table (Table 1). The latter figure was then

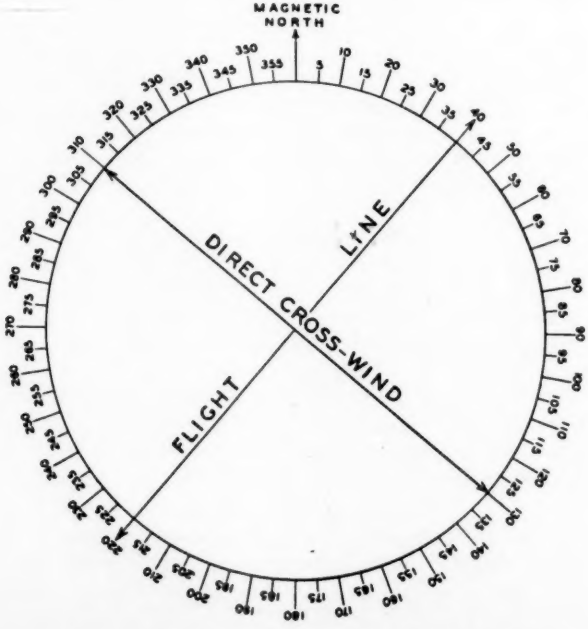

Fig. 1. Whitehorse, Y.T. Spray operation chart, 1950.

divided into the required height-wind product, e.g., 1,200. If at Whitehorse, for example, the line of flight were 220°, wind speed 5 m.p.h., and the direction 270°, the chart indicates that the direct cross-wind would be 310°. The wind direction would be therefore 40° off a direct cross-wind. The table shows that at 5 m.p.h. and 40° the cross-wind component is 4, which, divided into 1,200, gives a height of 300 ft. for the run.

WIND m. p. h.	ANGLE																
	5°	10°	15°	20°	25°	30°	35°	40°	45°	50°	55°	60°	65°	70°	75°	80°	85°
2	2	2	2	2	2	1.5	1.5	1.5	1.5	1.5	1.0	1.0	1.0	.5	.5	.5	.2
3	3	3	3	3	2.5	2.5	2.5	2.5	2.0	2.0	1.5	1.5	1.5	1.0	1.0	.5	.5
4	4	4	4	4	3.5	3.5	3.5	3.0	3.0	2.5	2.5	2.0	1.5	1.5	1.0	.5	.5
5	5	5	5	4.5	4.5	4.5	4.0	4.0	3.5	3.0	3.0	2.5	2.0	1.5	1.5	1.0	.5
6	6	6	6	5.5	5.5	5.0	5.0	4.5	4.0	4.0	3.5	3.0	2.5	2.0	1.5	1.0	.5
7	7	7	7	6.5	6.5	6.0	6.0	5.5	5.0	4.5	4.0	3.5	3.0	2.5	2.0	1.0	.5
8	8	8	7.5	7.5	7.0	7.0	6.5	6.0	5.5	5.0	4.5	4.0	3.5	2.5	2.0	1.5	.5
9	9	9	8.5	8.5	8.0	8.0	7.5	7.0	6.5	6.0	5.0	4.5	4.0	3.0	2.5	1.5	1.0
10	10	10	9.5	9.5	9.0	8.5	8.0	7.5	7.0	6.5	5.5	5.0	4.0	3.5	2.5	1.5	1.0
11	11	11	10.5	10.5	10.0	9.5	9.0	8.5	8.0	7.0	6.5	5.5	4.5	4.0	3.0	2.0	1.0
12	12	12	11.5	11.5	11.0	10.5	10.0	9.0	8.5	7.5	7.0	6.0	5.0	4.0	3.0	2.0	1.0
13	13	13	12.5	12.5	12.0	11.0	10.5	10.0	9.0	8.0	7.5	6.5	5.5	4.5	3.0	2.0	1.0
14	14	14	13.5	13.5	13.0	12.0	11.0	10.5	10.0	9.0	8.0	7.0	6.0	5.0	3.5	2.5	1.0
15	15	15	14.5	14.5	14.0	13.0	12.0	11.5	10.5	9.5	8.5	7.5	6.0	5.0	4.0	2.5	1.0

Table I. Table of cross-wind components, cos Θ by wind speed, for use in ascertaining flying heights for aerial spraying.

Several types of markers were used on the base line to guide the plane on each run. In the open, where the pilot had a clear vision, a fluorescent panel 12 ft. by 18 in. was held on two poles. In areas where trees or other obstructions were in the way, gas-filled meteorological balloons were held on a long cord, or smoke bombs or smoke puffs were set off. The most satisfactory was the smoke puff fired from a Very pistol. The charge went up 50 to 75 ft. before exploding and the resultant smoke was easily seen by the pilot. When the plane was out of sight of the ground party, the pilot called for the smoke signal by radio when he had completed his turn and was ready to line up for the next run.

Where possible a base line running through the centre of the area was selected, and the plane made a tear-drop turn at the end of each run and returned over the marker to spray in the opposite direction.

In the early trials all sprays were applied in the evening and it took three nights to cover the area. Later it was found more satisfactory to apply the spray as nearly as possible in one operation starting in the evening of one day, stopping for the short period of darkness, and continuing at daybreak, or as soon as the pilot could see to fly, and continuing until the job was completed, usually not later than 7 a.m. This method is suitable in the North, where during early summer the nights are short and cool and a long period of daylight occurs early in the morning before the ground warms up to cause upward convection and turbulence. Farther south, however, the longer nights make the method less suitable.

Assessments

Biological assessments of the results of the spray applications were made at all the stations except Norman Wells. Check points were established inside and outside the spray plot and checks were made twice daily of the landing rate, the biting rate, and the number of mosquitoes captured in ten sweeps of an insect net. The landing rate is the number of mosquitoes landing on the front of the trousers between the waist and the knee during a period of one minute shortly after the observer arrives at the check point. The biting rate is the number of mosquitoes biting the forearm between the wrist and the elbow during a one-minute check period.

Details of Operations

Table II gives a summary of the results of the airspray operations at the stations.

TABLE II.

SUMMARY OF DATA FROM AERIAL SPRAYING AGAINST *Aedes* MOSQUITOES WITH DDT–FUEL OIL SOLUTION AT AN AVERAGE DOSAGE OF 0.23 LB. OF DDT PER ACRE.

R.C.A.F. Station	Date Treated	Area Treated sq. mi.	Average Height-Wind Product	Sampling Points	Initial Control per cent
Whitehorse	June 13–15	11	1110	14	93
Whitehorse	June 30 – July 1	11	1017	14	98
Watson Lake	June 21–22	12	680	13	99
Ft. Nelson	June 6–8,	11	602	13	64
Ft. Nelson	19–20	11	683	13	70
Norman Wells	June 28–29	8	959	—	—

Whitehorse, Y.T.

The R.C.A.F. station at Whitehorse is situated in a valley in mountainous country along the Alaska Highway. To the east is the town of Whitehorse on the Lewes River and to the west is rolling terrain, leading up to the mountains. This is thickly covered with spruce, pine, poplar, and birch. Numerous swamps and pools in the depressions produce large numbers of *Aedes* spp. of mosquitoes each summer. In 1950 the mosquito infestation was severe.

Two sprays were applied, the first on June 13-15, and the second on June 30-July 1. As shown on the map (Fig. 2), a base line was staked out along the Alaska Highway and extended northwards along a road that branches from the highway about one mile from the R.C.A.F. station. Spray runs were made for approximately one mile westward from the base line and eastward to the bank of the Lewes River. The heavy lines indicate the first run of each load.

Results at Whitehorse were satisfactory. Good protection was given personnel within the sprayed area for six weeks during the height of mosquito activity. In addition to the station, the town of Whitehorse was included in the sprayed area. After the first spray, biological assessments showed no build-up

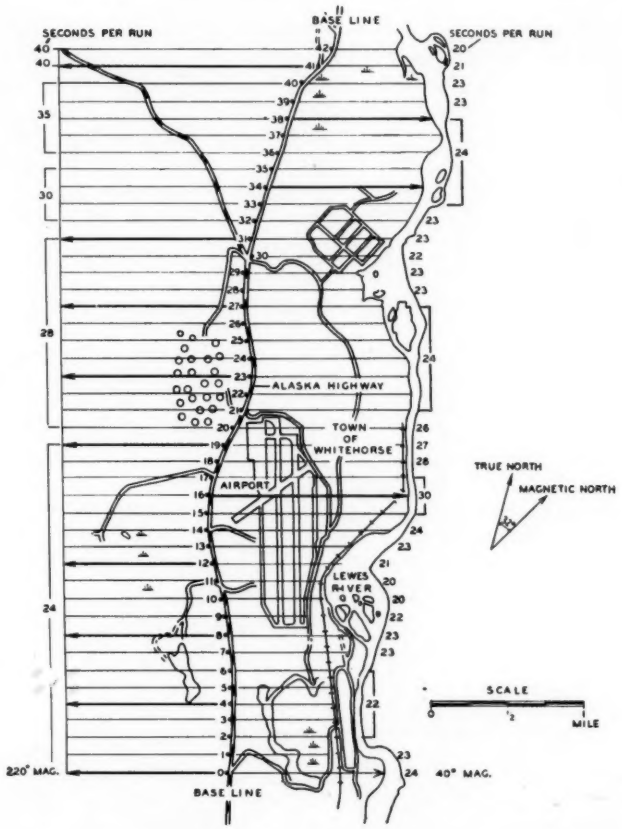

Fig. 2. Whitehorse, Y.T. Aeroplane spray plot layout for the guidance of pilot and ground crew, showing the marker numbers and the direction and emission period of each run. Heavy lines indicate first runs for the various loads.

of the mosquito population equal to that outside the treated area. Comparison of figures obtained at 14 stations inside and outside the sprayed area show approximately 93 per cent immediate control. Activity gradually increased inside the area until after ten days control was reduced to about 80 per cent.

Results of the second spray indicate an immediate control of 98 per cent; this lasted for two weeks, when some slight activity was recorded. The population gradually decreased outside the area during the latter part of July, thus decreasing the pressure on the sprayed area. For the last ten days of July no activity was recorded in the sprayed area, although mosquitoes were present outside. Data from mosquito population assessments at Whitehorse are shown graphically (Fig. 3). The graphs showing mosquito activity are drawn on points established from three-day averages of landing, biting, and sweeping counts.

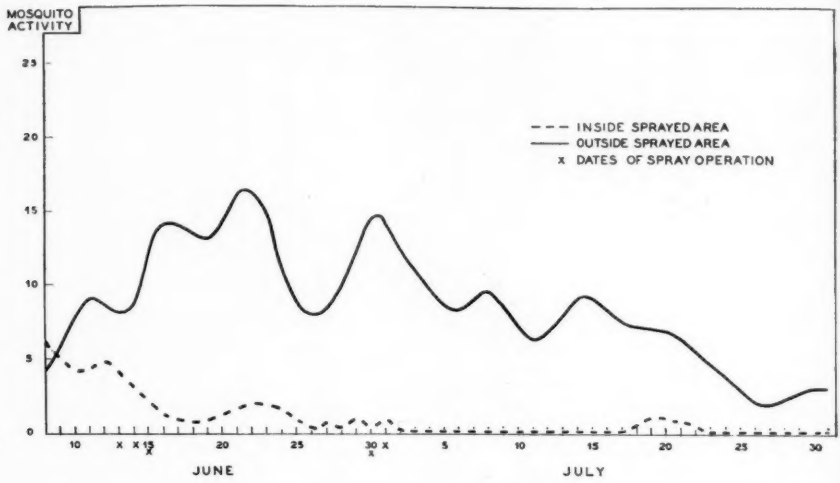

Fig. 3. Whitehorse, Y.T. Mosquito activity from June 8 to July 31, 1950. Averages of landing, biting, and sweeping counts.

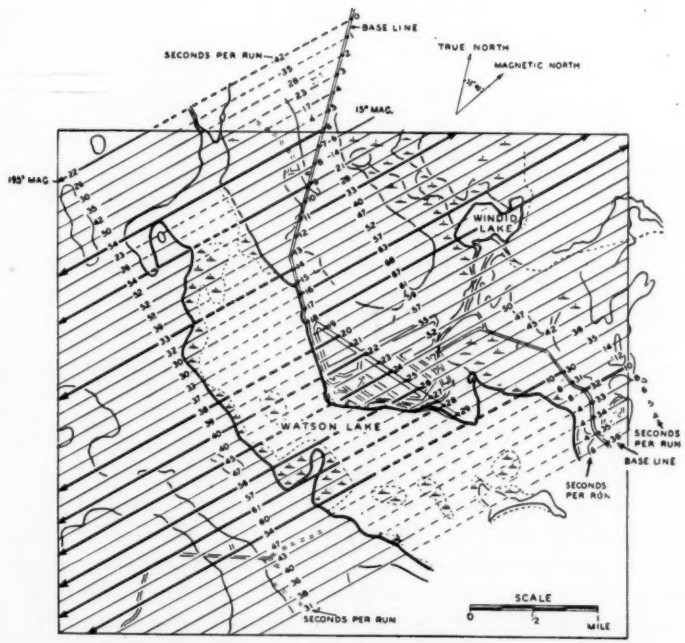

Fig. 4. Watson Lake, Y.T. Aeroplane spray plot layout for the guidance of pilots and ground crew, showing marker numbers and the direction and emission period of each run. Heavy lines indicate first runs for various loads and dotted lines indicate periods of non-emission, after passing over the marker.

Watson Lake, Y.T.

The R.C.A.F. station at Watson Lake is situated in a forested area on the north shore of a lake about 10 sq. mi. in area. Spruce, larch, and poplar are the predominant trees. Many swamps and bogs that flood in the spring and produce large numbers of *Aedes* spp. mosquitoes occur in the area. Although Watson Lake is 200 miles or more farther south the spring season is later there than at Whitehorse; as a result the mosquito population does not emerge until ten days to two weeks later. Slightly more than 12 sq. mi. were sprayed in the area for mosquito control on the evening of June 21 and the early morning of June 22. Except when work was suspended for about two hours because of darkness, the operation proceeded without interruption.

The base line was laid out along the radio range road to the end of the east-west runway, thence along the runway and out on its clear approach at the east. It was continued along the road leading to the Alaska Highway. Spray runs were made on 15° and 195° Mag., from the base line, and were of such a length as to complete a rectangle as shown on the map (Fig. 4). Heavy lines indicate the first run of each load.

Meteorological conditions for this operation were good and on each run the spray came down in an excellent pattern with sufficient overlap to give effective coverage. Almost 100 per cent mortality of mosquitoes was obtained and black flies also disappeared from the area. For the remainder of the season mosquitoes were not again a problem in the camp. Outside the sprayed area, however, their numbers increased, later diminishing gradually. The results of the assessments are presented graphically (Fig. 5).

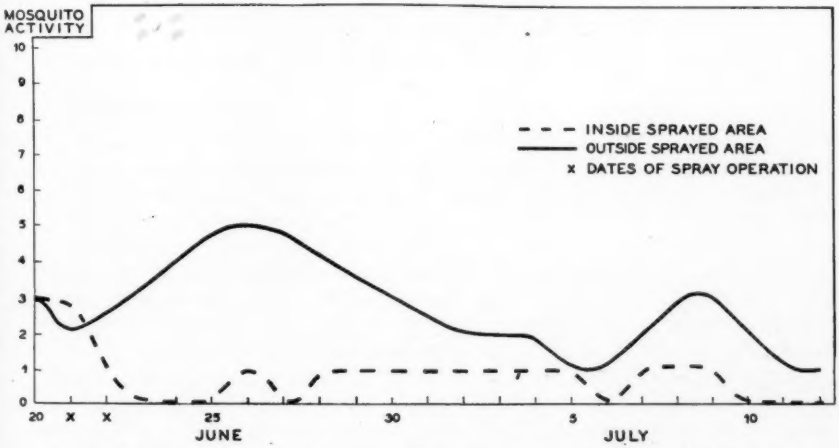

Fig. 5. Watson Lake, Y.T. Mosquito activity from June 20 to July 12, 1950. Averages of landing, biting, and sweeping counts.

Fort Nelson, B.C.

The R.C.A.F. station at Fort Nelson is a few miles from Mile 300 on the Alaska Highway, and is situated on a high plateau above the Nelson and Muskwa rivers. The area is heavily covered with larch, spruce, pine, and other trees, some of which reach heights of 75 to 100 ft. Swamp areas occur on all sides and mosquitoes are more numerous than at Whitehorse or Watson Lake.

In laying out the area (Fig. 6) the long runway and its cleared approaches were used as part of the base line. To the north this was extended along the road leading to an old garbage dump and into the woods and across McConachie Creek for several hundred yards. The base line was marked at 200-yd. intervals with steel pipes driven into the ground to form permanent markers.

Two sprays were applied: the first during the evenings of June 6-8, and the second on the evening of June 19 and the early morning of June 20.

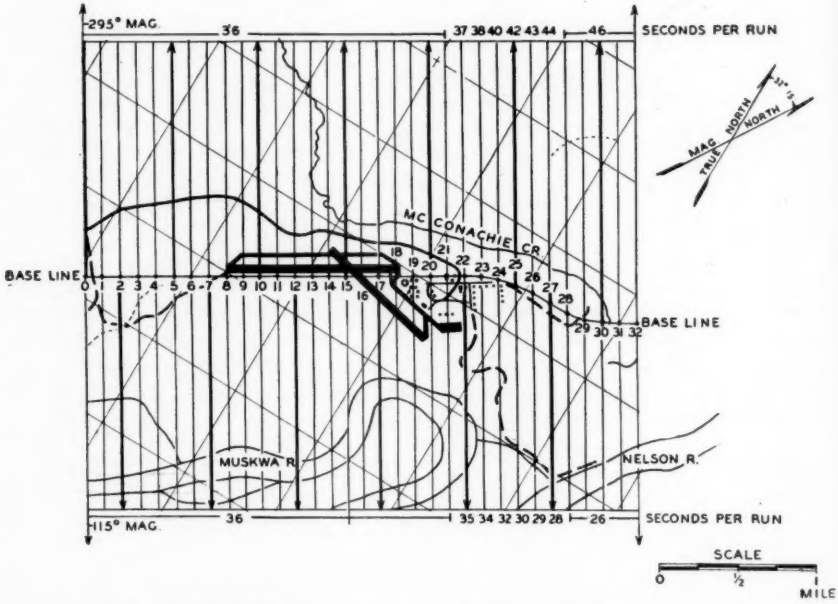

Fig. 6. Fort Nelson, B.C. Aeroplane spray plot layout for the guidance of pilots and ground crew, showing marker numbers and the direction and emission period of each run. Heavy lines indicate first runs.

The control obtained at Ft. Nelson was unsatisfactory. After the first spray the mosquito infestation was sharply reduced for a day or two, but then increased rapidly so that within a week it was as great as or greater than that outside the sprayed area. The second spray gave somewhat better results and fair control was indicated for a week, when the mosquito population began to decrease naturally, and no further serious annoyance was experienced. The failure of the first spray may have been due to several factors. Unfavourable meteorological conditions developed during the spraying and as a result coverage was incomplete. The wind changed direction twice to blow from opposite sides of the line of flight of the aircraft. Later it became calm so that a lower height-wind product than the formula required had to be used, as is explained in the section "Operation Procedure". Both conditions are likely to cause gaps in the spray pattern. Penetration of the spray may have been hindered by the tall trees in this heavily wooded area. Strong winds occurred during two days immediately after the spraying and may have blown mosquitoes into the sprayed area from outside. The results of the spray operation at Fort Nelson are shown graphically (Fig. 7).

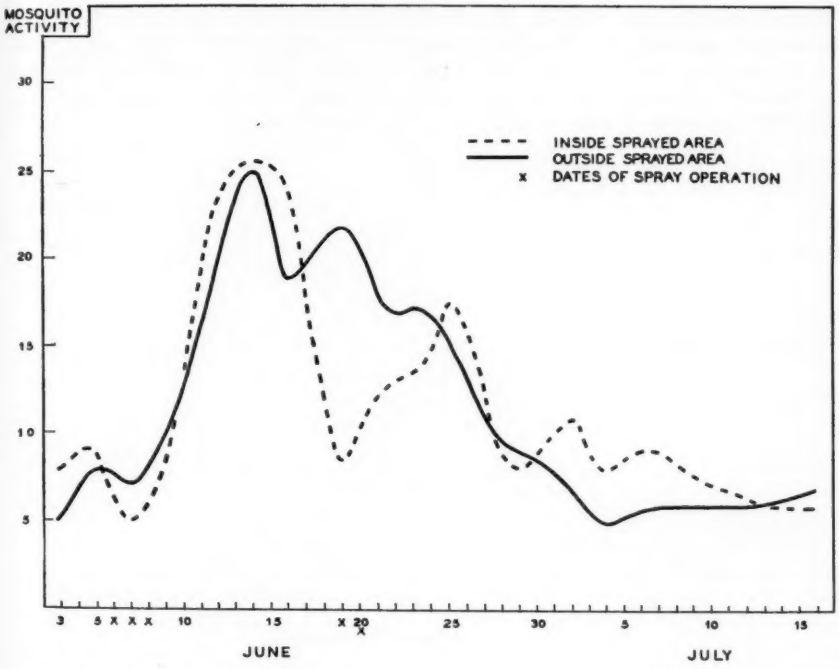

Fig. 7. Fort Nelson, B.C. Mosquito activity from June 3 to July 7, 1950. Averages of landing, biting, and sweeping counts.

Norman Wells, N.W.T.

Norman Wells is situated on the Mackenzie River, 50 mi. north of Fort Norman in the Northwest Territories. The river at this point is three to four miles wide. The camp, including the Imperial Oil site, is close to the river bank and the surrounding area is devoid of roads or trails. A heavy growth of poplar, spruce, willow, and birch, as well as other trees and shrubs, blankets the area. There are numerous swampy areas between the river and the Norman Mountain Range from which mosquitoes emerge in large numbers every year.

The area to be sprayed was laid out with the base line paralleling the river bank. The road running from the radio range through the camp and the Imperial Oil property was used for this purpose. The base line was four miles long and extended westward beyond this, as shown on the map (Fig. 8). The spray runs were two miles long, the total area treated being eight square miles.

On the evening of June 27 biting rates averaged five per minute and landing rates 15 to 25 per minute. The following evening, before spraying, biting and landing rates of more than 100 were recorded.

The spray operation was begun at 8.40 p.m. on June 29. The long summer day and the short period of twilight about midnight provided good light for the pilot to see the marker throughout the six hours it took to complete the job. There was a good cross-wind and the spray came down in an excellent pattern.

It was not possible to stay, or to leave an observer, to record the results of the spray by biological assessments. However, a report was submitted by

F/L. Bland, O.C. of the Norman Wells detachment. He stated that up to 15 days after spraying the mosquito nuisance was negligible and that the operation was a complete success. Personnel of the Imperial Oil Company who have been in the area a number of years reported to F/L. Bland that never before have they been so pleasantly free of mosquitoes during the season.

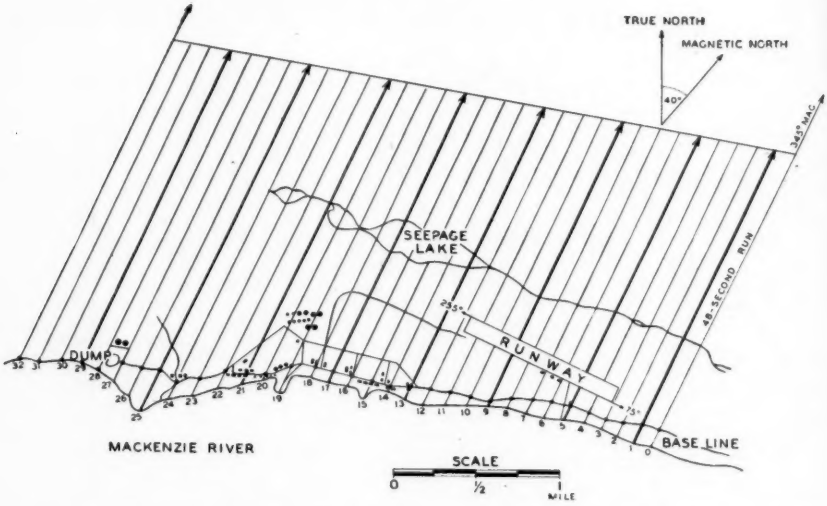

Fig. 8. Norman Wells, N.W.T. Aeroplane spray plot layout for the guidance of pilots and ground crew, showing marker numbers and the direction of each run. Heavy lines indicate first runs. Emission period was 48 sec. for each run.

Summary

Experimental area control of adult mosquitoes by airspray was carried out at four stations of the R.C.A.F. in the North West Air Command during the summer of 1950. Approximately 42,240 acres (66 sq. mi.) were treated with 66 drums of 30 per cent DDT concentrate in Velsicol AR-50 and 30,000 gal. of fuel oil; three quarts per acre of a 3.5 per cent DDT solution gave a coverage of 0.23 lb. of DDT per acre.

Approximate percentage control at the stations as determined by biological assessments of the spray plots before and immediately after the application was as follows: Whitehorse, 1st spray, 93, 2nd, 98; Watson Lake, 99; Fort Nelson, 1st spray, 64, 2nd, 70.

At Whitehorse, Watson Lake, and Norman Wells good control was maintained during the season. The first spray at Fort Nelson gave fair control for about two days and the second for seven days, after which the mosquito population decreased to negligible numbers in both treated and untreated areas.

Acknowledgments

The excellent co-operation of all the officers and men of the R.C.A.F. who were involved in this project is acknowledged. Thanks are also due Dr. C. R. Twinn, Head, Household and Medical Entomology Unit, Division of Entomology, Ottawa, and Dr. A. W. A. Brown, Head. Department of Zoology,

University of Western Ontario, London, Ont., for valued advice and assistance, and to Mr. L. M. Fisher, Division of Entomology, Ottawa, for assistance in all the field experiments.

References

Gunn, D. L. 1948. Aircraft spraying against the desert locust (*Schistocerca gregaria* Forskal) in Kenya, 1945. *Anti-Locust Research Centre (London) Bull.* 4.

Goldsmith, J. B., C. N. Husman, A. W. A. Brown, W. C. McDuffie, and J. F. Sharp. 1949. Exploratory studies on the control of adult mosquitoes and black flies with DDT under Arctic conditions. *Mosquito News* 9: 93-97.

Twinn, C. R., A. W. A. Brown, and H. Hurtig. 1950. Area control of mosquitoes by aircraft in sub-arctic Canada. *Proc. 37th Ann. Meet. New Jersey Mosquito Exterm. Assn.*, pp. 113-140.

A Simple Apparatus for Feeding Aphids Aseptically on Chemically Defined Diets[1]

By J. B. MALTAIS[2]

Science Service Laboratory, St. Jean, Que.

Nutritional studies on plant sucking insects have not made outstanding progress in the past decade. The information on the rearing of aphids on prepared liquid foods is rather scanty. Carter (1927, 1928, 1945) developed techniques for the artificial feeding of homopterous insects, particularly leafhoppers and mealybugs. Fife (1932) and Severin *et al.* (1928) devised cages for the artificial feeding of leafhoppers. These authors suggested many excellent ideas on the use of membranes, but the works of Hamilton (1930, 1935) on the green peach aphid, *Myzus persicae* (Sulz.), appear to be the most thorough source of information on the artificial feeding of aphids. Pletsch (1937) also developed a device for the artificial feeding of aphids and his apparatus presents several advantages over previously described devices. Various types of cages and membranes were used by the above workers with limited success. They have all succeeded in getting homopterous insects to feed temporarily on special diets through different types of membranes, but they were unable to maintain the development of these insects and have them reproduce under artificial conditions.

For nutritional studies on aphids, under aseptic conditions, the type of feeding cage to be used is of prime importance. An adequate cage must (1) be made of materials easily and effectively sterilized by steam heat, i.e., glass, rubber, (2) be relatively small for economy of materials and convenient handling under the low-power binocular microscope, (3) be bacteria-proof for the prevention of food contamination, (4) be constructed so as to have parts interchangeable for convenient and rapid assembling, and (5) provide adequate conditions for the free development of the insects.

Carter (1927, 1928) and Hamilton (1930, 1935) used various types of membranes such as animal mesentery "fish-skin", baudruche capping skins, plant epidermis, and paraffin with some success for short feeding periods. The writer has tried the above membranes with equally limited success. Natural animal or vegetable membranes are not bacteria-proof and they cannot be sterilized by steam heat or kept sterile with chemical germicides.

The feeding and rearing apparatus here described combines all the basic characteristics required for efficiency and also overcomes the disadvantages encountered with the various feeding cages previously reported. Fig. 1 shows the component parts and Fig. 2 illustrates the cage ready for use. The apparatus

[1]Contribution No. 2943, Division of Entomology, Science Service, Department of Agriculture, Ottawa, Canada.

[2]Officer-in-Charge, Resistance of Plants to Insects.

measures 65 mm. in height and 25 mm. in width at the base. It is composed of five parts as follows: A, a glass rearing chamber or cell, 25 mm. wide, 20 mm. high, with a side tube for aeration. The escape of aphids is prevented by placing a small wick of cotton gauze (A_1) into the tube. The rearing chamber is partly filled with plaster of Paris kept moist to maintain the high humidity necessary for aphids. B, a rubber ring, 4 mm. thick, 20 mm. in diameter, and made of a slice from the narrow end of a No. 4 rubber stopper. The slice is bored with a No. 8 cork borer 15 mm. in diameter. C, a natural rubber membrane made of light-colour toy balloon, very thin grade (especially made by Tillotson Rubber Company, St. Jean, Que.). Before being used, the balloons must be fully inflated for at least 48 hours to reduce the thickness further. D, a glass container, 30 mm. high, 15 mm. wide, for the sterilized liquid food, and E, a rubber cap "policeman" to close the food container.

The apparatus is assembled by laying the rubber membrane (C) over the rubber ring (B) and pressing down together the membrane and the food container (D) through the rubber ring. The rubber ring should be dipped in water before inserting the membrane; this facilitates the operation and prevents too much stretching of the membrane. When the membrane is set in place and neatly trimmed with scissors, the food container, the membrane, and the ring are fitted snugly upon the rearing chamber (A) as shown in Fig. 2 and the whole apparatus is ready for use.

This cage was tested several times for the basic characteristics set forth at the beginning of this paper. The cage withstands sterilization in the autoclave at 15 pounds steam pressure for 30 minutes. It is not affected by chemical germicides such as formaldehyde, bichloride of mercury, and ethylene oxide. It occupies very little space, observations within the rearing chamber can easily be made under the dissecting binocular microscope, the membrane is bacteria-proof, and the aphids appear to be undisturbed by artificial conditions in the rearing chamber. Care should be taken, however, to prevent static electricity on the membrane and in the cage.

To ascertain the efficiency of the rubber membrane, two sets of cages containing a given number of full-grown aphids were placed under observation. One set had pure water in the food container; the other had neither food nor water. In the first group, the aphids lived from three to five days; in the second group, they all died within two days. This preliminary experiment indicated that the aphids pierced the rubber membrane and took enough water to prolong the starvation period. Newly born as well as full-grown aphids pierce the membrane.

The feeding action through the membrane was ascertained by means of a specially devised shallow cell (Fig. 3) for observation under the high-power microscope. The cell is composed of the following parts: A, a standard microscope slide; B, a round cover slip 18 mm. in diameter; C, a glass ring 12 mm. wide by 4 mm. deep; D, an extra-thin rubber membrane; and E, a rubber ring 5 mm. deep with a bore 11 mm. in diameter. In this observation cell, the rubber membrane is easily pierced by the sharp ends of the aphid stylets, which move rapidly in all directions in a drop of feeding medium placed on the upper surface of the cell.

This feeding and rearing apparatus was devised for nutritional studies under artificial conditions, especially for the prevention of bacterial contamination of the liquid diets given to aphids. Research on a basic synthetic diet for aphids is continuing with the object of studying the nutritional factors as causes of plant resistance to aphids.

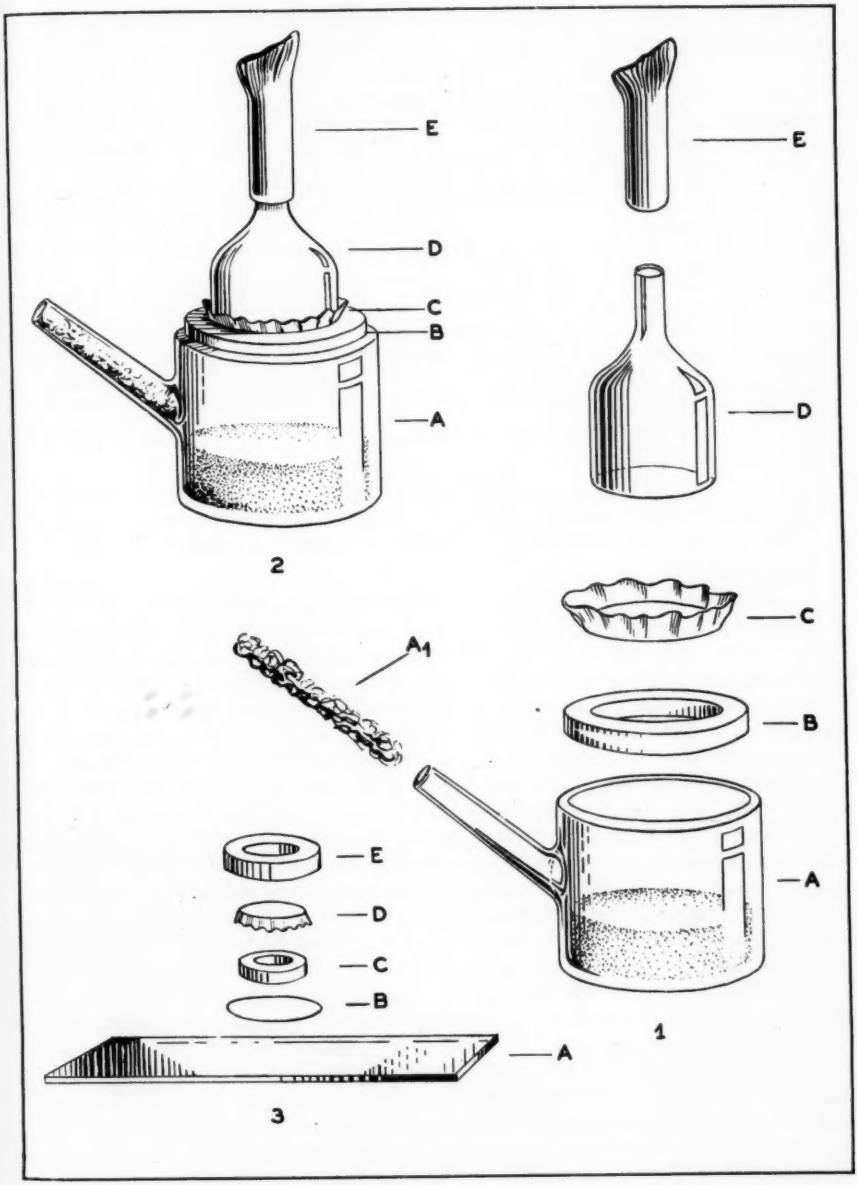

Fig. 1. The component parts of the apparatus for the feeding of aphids.
Fig. 2. The feeding cage ready for use.
Fig. 3. The component parts of the observation cell.

The writer extends sincere thanks to Mr. J. G. Smith, Vice-President, Tillotson Rubber Company, St. Jean, Que., for manufacturing an extra-thin grade of toy balloon envelope for experimental purposes. Thanks are also due

to Miss B. Fortin for her assistance in rearing aphids and ensuring an adequate population of the insects for study.

References

Carter, W. 1927. A technique for use with homopterous vectors of plant disease, with special reference to the sugar-beet leafhopper, *Eutettix tenellus* (Baker). *J. Agr. Res.* 37: 449.
Carter, W. 1928. An improvement in the technique for feeding homopterous insects. *Phytopathology* 18: 246.
Carter, W. 1945. The oral secretions of the pineapple mealybug. *J. Econ. Ent.* 38: 335.
Fife, J. M. 1932. A method of artificially feeding the sugar-beet leafhopper, *Eutettix tenellus* (Baker). *Science* 75: 465.
Hamilton, M. A. 1930. Notes on the culturing of insects for virus work. *Myzus persicae* (Sulz.). *Ann. App. Biol.* 17: 487.
Hamilton, M. A. 1935. Further experiments on the artificial feeding of *Myzus persicae* (Sulz.). *Ann. App. Biol.* 22: 243.
Peterson, A. 1937. A manual of entomological equipment and methods. Parts I and II. Edwards Brothers, Inc., Ann Arbor, Michigan.
Pletsch, D. J. 1937. Improved device for artificial feeding of aphids. *J. Econ. Ent.* 30: 211.
Severin, H. H. P., and O. Swezy. 1928. Filtration experiments on curly top of sugar beets. *Phytopathology* 18: 681.

Book Reviews

Chemical Control of Insects. **By T. F. West, J. E. Hardy, and J. H. Ford. Pp. xl and 211; 44 figures. London, Chapman & Hall Ltd. 1951. 15 shillings net.**

The publication date of this book is misleading. Published in 1951 in the Frontiers of Science Series, the book may reasonably be expected to meet the claims made for the series on the dust cover: to take its readers "to the forefront of scientific progress", and "to make clear the most important growing points of contemporary science". In these respects the book is disappointing for it is out of date. The preface is undated, but it is clear from the text that the manuscript was prepared prior to 1948. This gap between preparation and publication is large indeed when viewed in terms of the developments in chemical control of insects during the past three or four years.

Probably the most important "growing points" in insecticide research are: the development of the chlorinated persistant insecticides, the finding that certain insects acquire a tolerance to these insecticides, and the discovery of the insecticidal properties of certain organo-phosphorus compounds. The importance of the first of these is adequately indicated in a chapter dealing with DDT, BHC, Chlordane and Toxaphene; later arrivals in this group are not mentioned because the chapter contains no references later than 1946. Acquired tolerance to insecticides is neither mentioned nor anticipated, although the first reports of this phenomenon were published in 1947. The organo-phosphorus insecticides, HETP and parathion, are included with references (1948) to the latter apparently added in proof; the systemic insecticides, first reported in 1947, are not mentioned. More important than these omissions is the failure to notice adequately the real frontier of insecticide research—the elucidation of the mode of action of insecticides. Apart from a long quotation from Slade on his hypothesis, since discredited, on the mode of action of BHC, there is only a casual reference to the dehydrochlorination hypothesis of Martin and Wain. Curiously, Metcalfe's excellent review of this subject is cited, but only to support a statement on the chemical properties of parathion.

The main parts of the book are devoted to accounts of the older insecticides, and these are uniformly well done. There are valuable summaries on nicotine, rotenone, arsenicals, petroleum oils, coal tar derivatives, pyrethrum, "Lethanes",

"Thanite", and miscellaneous insecticides including sabadilla, fluorine and sulfur compounds. Fumigants are treated in two chapters, one dealing with stored products and the other with soils; ethylene dibromide, important in both fields, is not included. There is a chapter on repellents and attractants and one on weed control. Each compound is treated separately with an account of its history, chemistry, methods of application, and the species of insects affected. Introductory chapters on the insect and on the general features of pest control are well designed to orientate the new-comer to the subject.

The Frontiers of Science Series is addressed to "scientists who wish to understand what is happening in subjects other than their own". This is an audience to whom economic entomology owes much, for recent advances in insecticide research have drawn heavily on the resources of other sciences. A compact, up-to-date account of the salient developments in chemical control of insects with emphasis on work seeking the relations between chemical structure and toxicity, and the biochemical bases of insecticidal action would be usefully addressed to this audience. Lacking this emphasis and many findings pertinent to it, the present book fails, in 1951, to fulfill the purpose of the series.

BEVERLEY N. SMALLMAN

The Sucking Lice. **By G. F. Ferris, with the collaboration of C. J. Stojanovitch. Pp. ix and 320; 124 text-figures. Memoirs of the Pacific Coast Entomological Society, Volume 1. San Francisco. $6.00. 1951.**

Students of ectoparasites have hoped that Ferris' notable series of papers entitled *Contributions toward a Monograph of the Sucking Lice*[1] would be completed by a final part in which the higher classification would be treated. This has not been forthcoming, but the present volume supplies the lack and more, embodying, besides Ferris' views on the systematic position of the Anoplura and the classification of the group, chapters on morphology and anatomy, growth and development, host relationships, and distribution.

The book is lithoprinted, and nicely bound. Although this does not appear to be mentioned, many of the excellent illustrations are borrowed from previous work by the author and his collaborator. However, new cuts have been made and the figures on the plates have been re-labelled, and in some cases rearranged and touched up. New figures are presented for species described since 1935, and some of the "older" species have been redrawn.

A brief chapter on the ectoparasites of birds and mammals is followed by a longer one on the morphology and anatomy of the Anoplura. In this, C. J. Stojanovitch collaborated extensively, making the dissections and preparing the illustrations. Some of the information presented in this valuable chapter is derived from previous papers by the authors and others in *Microentomology* and elsewhere. Although comparisons are made with many genera, the descriptive matter and illustrations are based principally upon the familiar species *Pediculus humanus* L., *Haematopinus suis* (L.), and *Linognathus vituli* (L.).

A short chapter deals with growth and development and is accompanied by detailed drawings of eggs and instars of several species.

The major section of the book deals with the taxonomy of the Anoplura, the history of which is dealt with in summary. The section on classification is of particular interest, presenting Ferris' matured views on the subject, after more than 30 years of study.

Ferris treats the Anoplura as ordinally distinct from the Mallophaga (including Rhynchophthirina), thereby differing markedly from Hopkins[2], who follows

[1]Published in 8 parts between 1919 and 1935 as Volume II of "Leland Stanford Junior Publications, University Series" (in part) and "Stanford University Publications, University Series, Biological Sciences" (in part).

Weber in considering Anoplura, Mallophaga, and Rhynchophthirina as suborders of an order for which he adopts Haeckel's name, Phthiraptera. Under Anoplura, Hopkins recognized three families only, whereas Ferris lists six. The reviewer, not a specialist in the lice, is not able to comment with authority on these divergent viewpoints, each of which is supported by impressive arguments. However, as Ferris freely admits, the last word on the taxonomy and zoology of the groups has not been written.

Definitions, notes, and bibliographies are provided for the families; one new family, Hoplopleuridae, and three new subfamilies, Hoplopleurinae, Hybophthirinae, and Polyplacinae, are proposed. Genera, including one new one, *Werneckia*, are described and annotated. Keys are provided to genera and species.

Approximately 250 species are discussed, and four new ones, *Hoplopleura cricetuli*, *H. reithrodontomydis*, *Neohaematopinus ceylonicus*, and *Linognathus petasmatus*, are described. In general, descriptive notes on the species (other than the keys) are not provided, but pertinent references, and notes on hosts and distribution, are supplied. One or more species of each genus is fully illustrated. Complete descriptions, with figures, of nearly all the species are to be found in the *Contributions*, which should be used together with this book.

Valuable discussions are provided on a number of controversial nomenclatorial problems, and other matters, with particular reference to the domestic species, and Ferris is characteristically forthright in his opinions. The case of *Pediculus humanus* is dealt with at length, and Ferris adopts rather stern measures with a clutter of specific, subspecific, racial, and varietal names, reducing them all to synonymy. He points out that much research experimentation should be undertaken before the subspecific or varietal situation can be properly assessed. However, if the head louse and the body louse *are* to be separated nomenclatorially, it is not clear (cf. pp. 267 and 269) to which of these forms the name *Pediculus humanus humanus* belongs. In earlier work, Ferris has vigorously defended the application of this name to the body louse.

No special comment is made on *Pthirus gorillae* Ewing, although Hopkins (op. cit., p. 451) presented evidence that the specimens on which the description was based were derived from the heads of native porters, and almost certainly represented *P. pubis* (L.).

The taxonomic section is followed by a host list, and a chapter on the distribution of the Anoplura, and the book ends with two indices, one to the lice and one to the hosts. There is no bibliography. The chapter on distribution is of particular interest, and deals with the history of the association of lice with mammals. Although the book seems to be fairly free of typographical or other errors, one amusing *lapsus* in this section gives Professor Ferris the appearance of making a statement of unparalleled conservatism: "The hypothesis that the phylogeny of the lice and the phylogeny of the Anoplura are correlated is entirely tenable."

Professor Ferris is to be congratulated on preparing a book of great value, presented with the authority and clarity that one has learned to expect from him. The Pacific Coast Entomological Society is to be commended for selecting so timely and masterly a work as the opening volume of its Memoirs.

G. P. HOLLAND

[2]Hopkins, G. H. E., 1949, The host-associations of the lice of mammals, *Proc. Zool. Soc. Lond.* 119: 387-604; Fig. 122.

THE RUNGE PRESS LIMITED, OTTAWA
Mailed: Friday, October 3rd, 1952